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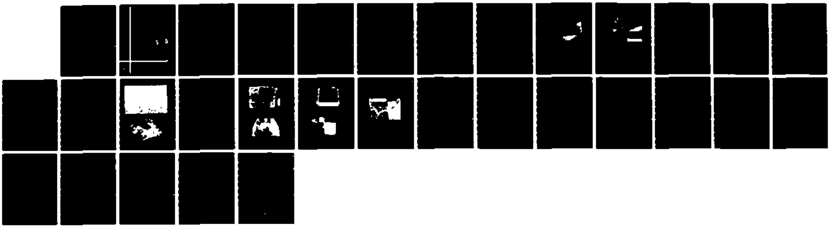

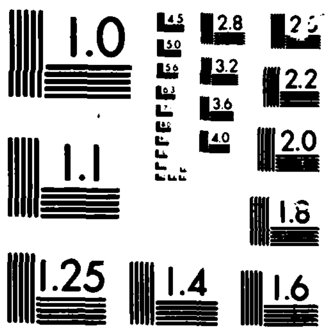

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Technical Memorandum

UNITED STATES NAVY - CANADIAN FORCES
SOLID STATE FLIGHT DATA RECORDER/CRASH POSITION LOCATOR
EXPERIMENT ON THE B-720 CONTROLLED IMPACT DEMONSTRATION

by

Mr. D. M. Watters

Systems Engineering Test Directorate

11 November 1985

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TM 85-76 SY
11 November 1985

The United States and foreign military forces and air carriers use both deployable and nondeployable Flight Data Recorder/Crash Position Locator (FDR/CPL) systems on their aircraft. New solid state nonvolatile memory technology has been used to make FDR/CPL system development feasible, reliable, survivable, and cost effective. Recognizing this, NAVAIRSYSCOM (AIR-330) has sponsored the development, test, and evaluation of three Solid State FDR/CPL (SSFDR/CPL) systems. The SSFDR/CPL system developed for the B-720 is the last of these sponsored jointly by AIR-330 and the Canadian Forces under the auspices of the international Air Standardization Coordinating Committee, Working Party 19, Airborne Electronic Equipment, and Test Project Agreement (TPA 805-19). This Technical Memorandum reports the results of the survivability testing of the SSFDR/CPL during the B-720 Controlled Impact Demonstration conducted by the Federal Aviation Administration and National Aeronautics and Space Administration on 1 December 1984. The conclusions and recommendations are supported by the data contained herein.

APPROVED FOR RELEASE:

J K Ready

J. K. READY
Commander, Naval Air Test Center

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SOLID STATE FLIGHT DATA RECORDER (SSFDR)
CRASH POSITION LOCATOR (CPL)
RADIO BEACON AIRFOIL (RBA)
B-720 CONTROLLED IMPACT DEMONSTRATION (CID)
SURVIVABILITY

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A prototype Solid State Flight Data Recorder/Crash Position Locator (SSFDR/CPL) developed jointly by the United States Navy/Canadian Forces was installed, tested, and evaluated aboard the Federal Aviation Administration/National Aeronautics and Space Administration B-720 Controlled Impact Demonstration (CID) on 1 December 1984. The SSFDR contained eight Electronically Erasable Programmable Read Only Memory silicon nitride oxide semiconductors with prerecorded (alternating ones and zeros) data. The CPL Radio Beacon Airfoil (RBA) contained a dual frequency (121.5 and 243 MHz)

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Cont. emergency locating beacon and a Visual Marker Strobe (VMS) powered by a lithium sulpher dioxide ($LiSO_2$) battery pack. The B-720 RBA installation also included an improved prototype squib actuated release system. The SSFDR/CPL/RBA was designed to be released by a frangible switch in the belly of the B-720 upon crash impact. However, the RBA did not deploy from the aircraft until after it was exposed to the initial fuel fire (approximately 20 sec at approximately 900°C) and until the sliding aircraft came to rest. Upon RBA deployment, the CPL transmitted on both frequencies for about 5 to 10 sec before being shorted by the ingress of crash fluids into the RBA cavity containing the Transmitter Module Assembly. The VMS operated for an undetermined period of time after crash impact. The SSFDR/CPL/RBA was found approximately 15 ft from the aircraft vertical stabilizer. Although the CPL and VMS were not operating, the system survived the B-720 CID in good condition. There was no damage to or data lost from the SSFDR. The RBA sustained only minor mechanical impact damage and no thermal damage. The survivability test of the SSFDR/CPL/RBA aboard the B-720 CID is considered to have been highly successful from an operational reliability standpoint. Further development, test, and evaluation will be conducted on the SSFDR/CPL/RBA such as integration of the AN/PRC-112(V) overt/covert Personal Location Beacon, integration of a 406 MHz SARSAT transmitter, and use of a three mode long range 121.5/243 MHz overt CPL.

SUMMARY

A prototype Solid State Flight Data Recorder/Crash Position Locator (SSFDR/CPL) developed jointly by the United States Navy/Canadian Forces was installed, tested, and evaluated aboard the Federal Aviation Administration/National Aeronautics and Space Administration B-720 Controlled Impact Demonstration (CID) on 1 December 1984. The SSFDR contained eight Electronically Erasable Programmable Read Only Memory silicon nitride oxide semiconductors with prerecorded (alternating ones and zeros) data. The CPL Radio Beacon Airfoil (RBA) contained a dual frequency (121.5 and 243 MHz) emergency locating beacon and a Visual Marker Strobe (VMS) powered by a lithium sulpher dioxide ($LiSO_2$) battery pack. The B-720 RBA installation also included an improved prototype squib actuated release system. The SSFDR/CPL/RBA was designed to be released by a frangible switch in the belly of the B-720 upon crash impact. However, the RBA did not deploy from the aircraft until after it was exposed to the initial fuel fire (approximately 20 sec at approximately 900°C) and until the sliding aircraft came to rest. Upon RBA deployment, the CPL transmitted on both frequencies for about 5 to 10 sec before being shorted by the ingress of crash fluids into the RBA cavity containing the Transmitter Module Assembly. The VMS operated for an undetermined period of time after crash impact. The SSFDR/CPL/RBA was found approximately 15 ft from the aircraft vertical stabilizer. Although the CPL and VMS were not operating, the system survived the B-720 CID in good condition. There was no damage to or data lost from the SSFDR. The RBA sustained only minor mechanical impact damage and no thermal damage. The survivability test of the SSFDR/CPL/RBA aboard the B-720 CID is considered to have been highly successful from an operational reliability standpoint. Further development, test, and evaluation will be conducted on the SSFDR/CPL/RBA such as integration of the AN/PRC-112(V) overt/covert Personal Location Beacon, integration of a 406 MHz SARSAT transmitter, and use of a three mode long range 121.5/243 MHz overt CPL.

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TABLE OF CONTENTS

	Page No.
INTRODUCTION	1
SSFDR DEVELOPMENT	3
CPL DEVELOPMENT	5
B-720 SSFDR/CPL CID	7
POST B-720 CID ANALYSIS OF THE RBA-46 SSFDR/CPL	10
INITIAL INSPECTION	10
PAYLOAD CAVITY ANALYSIS	10
SSFDR ANALYSIS	13
TRANSMITTER MODULE ASSEMBLY (TMA) ANALYSIS	14
POWER SUPPLY ANALYSIS	14
ANTENNA ANALYSIS	15
AN/PRC-112(V) INTERFACE ANALYSIS	15
VMS ANALYSIS	15
RBA-46 CPL MECHANICAL DAMAGE ANALYSIS	15
THERMAL ANALYSIS	15
B-720 SSFDR/CPL CID CONCLUSIONS	17
RECOMMENDATIONS FOR FUTURE SSFDR/CPL IMPROVEMENTS	17
REFERENCE	19
DISTRIBUTION	21

INTRODUCTION

1. The Solid State Flight Data Recorder/Crash Position Locator (SSFDR/CPL) project was established in January 1983 as a joint United States Navy/Canadian Forces (USN/CF) project under the auspices of the International Air Standardization Coordinating Committee (ASCC) Working Party 19 Airborne Electronic Equipment and Test Project Agreement (TPA 805-19). The prototype SSFDR and CPL Radio Beacon Airfoil (RBA-46) was developed by Leigh Instruments, Ltd., Carleton Place, Ontario, Canada, configured for Boeing B-707 or B-720 type aircraft. Standard United States Air Force E-3A (B-707) AN/URT-26(V)19 Radio Beacon Set Base (MRU-27), Battery Assembly (AUR-21), and ejection frangible switches were installed in the National Aeronautics and Space Administration (NASA)/Federal Aviation Administration (FAA) B-720 aircraft by personnel from NAVAIRTESTCEN, Patuxent River, Maryland, and NARF, North Island, San Diego, California. Later, the prototype RBA-46 and Dispenser (ARU-21) were installed and ground tested in the B-720 aircraft. This SSFDR/CPL system (figures 1 and 2) was aboard the NASA/FAA B-720 aircraft (figure 3) during the Controlled Impact Demonstration (CID) conducted on 1 December 1984 at NASA Dryden Flight Research Facility, Edwards, California.

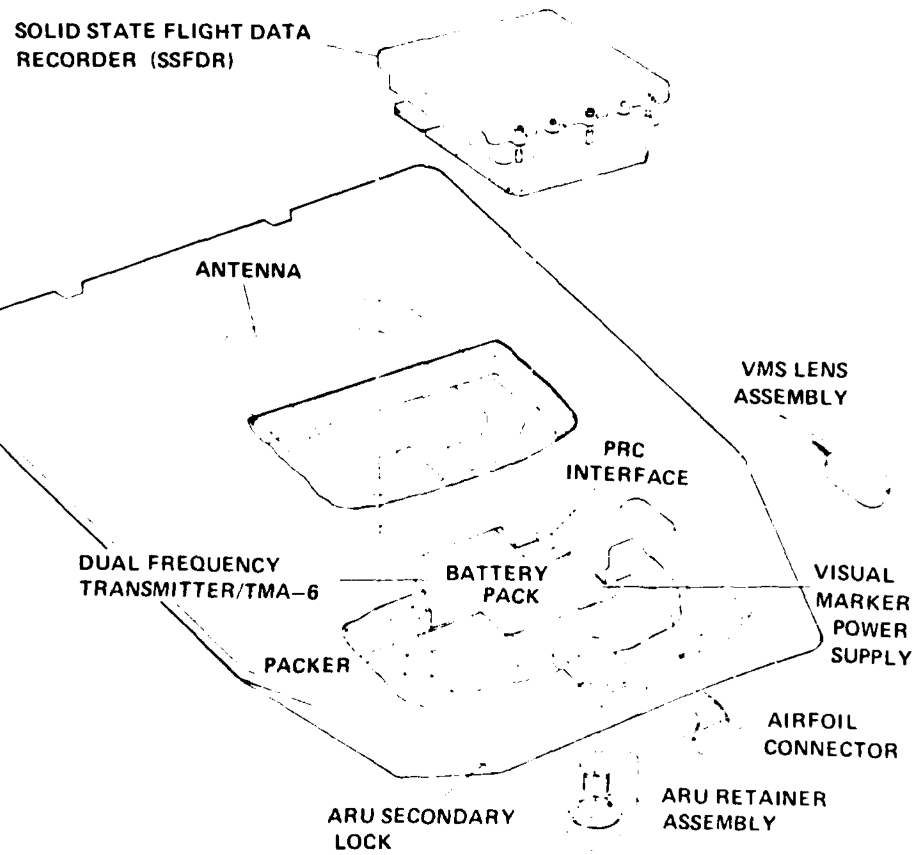

Figure 1
B-720 AIRFOIL (RBA-46) PAYLOAD CONFIGURATION

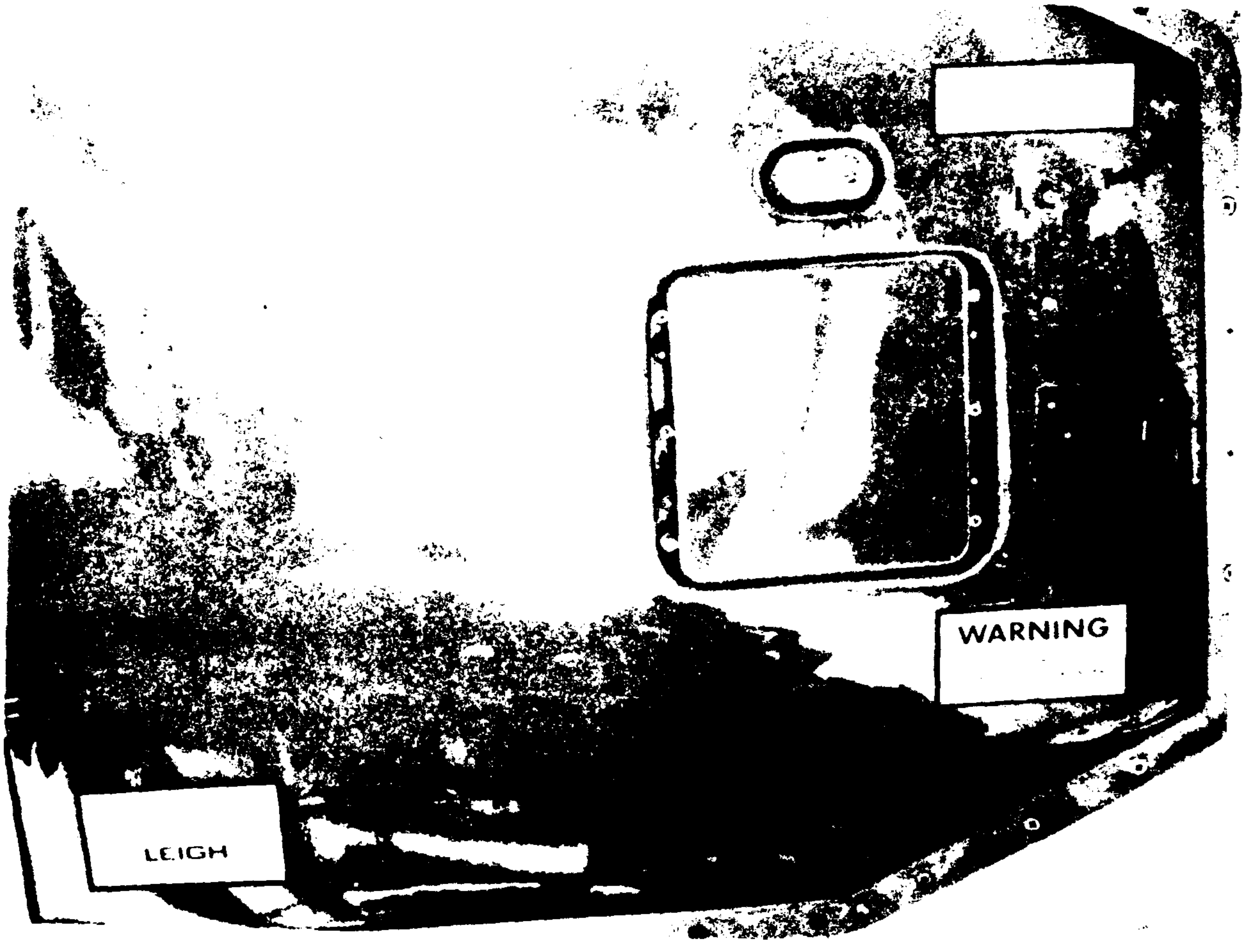

Figure 2
B-720 AIRFOIL (RBA-46) PRE-CID HARDWARE

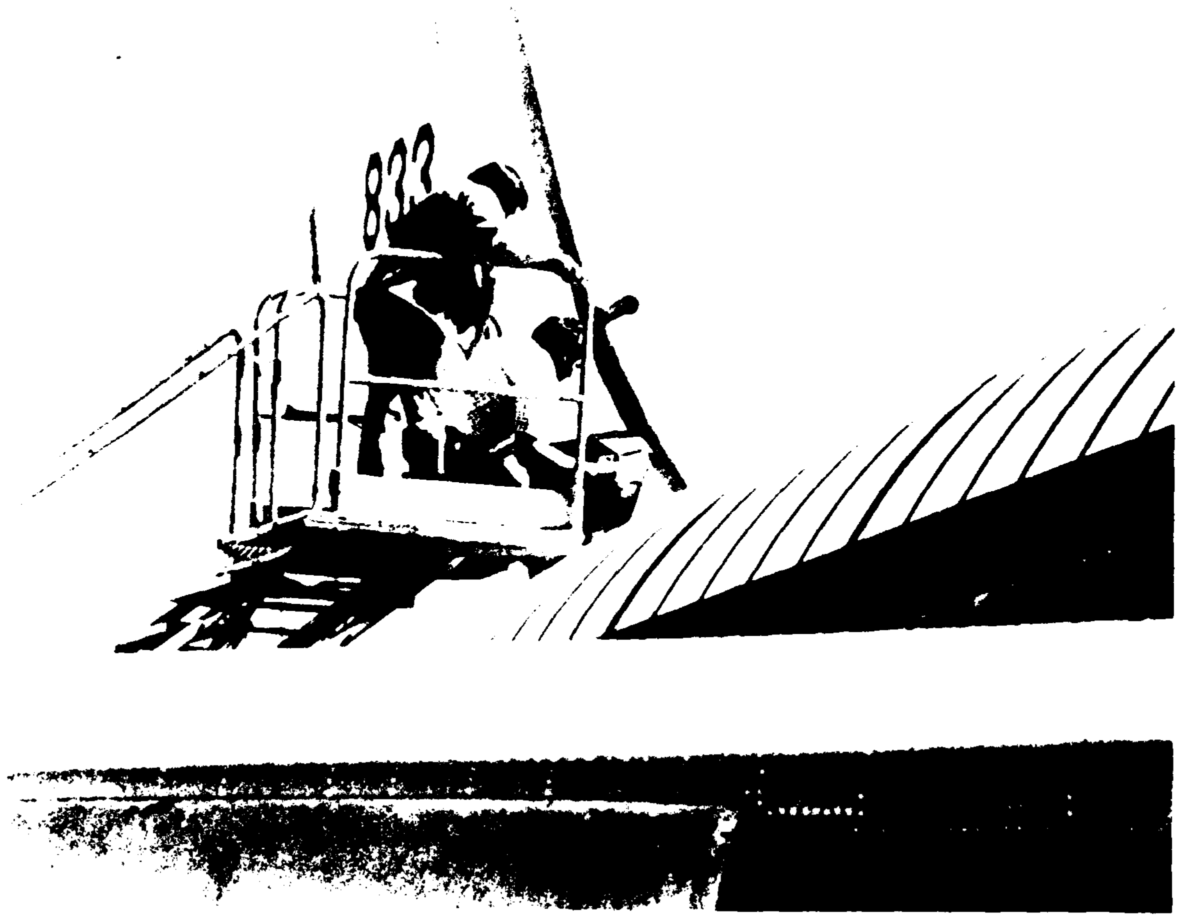

Figure 3
B-720 AIRCRAFT/RBA-46 AIRFOIL INSTALLATION

SSFDR DEVELOPMENT

2. The SSFDR shown in figure 4 was designed using Electronically Erasable Programmable Read Only Memory (EEPROM) Silicon Nitride Oxide Semiconductor (SNOS) chip technology as specified below:

Device Specification

Type	- EEPROM, NCR 52832, SNOS
Capacity	- 32 Kbits (4K X 8)*
Write Rate	- 12.8 Kbits/sec
Read Rate	- 500 Kbits/sec
Erase Rate	- 300 Kbits/sec
Endurance	- 10^5 cycles/memory cell
Retention	- 30 days at stated endurance
Operating Voltage	- 5 VDC $\pm$10%
Packaging	- Encapsulated surface mount technology
Operating Temperature	- -55°C to +125°C

Internal Module Specification

Form Factor	- 2.6 X 1.8 X 0.3 in. (1.4 in.^{3})
Number of Devices	- Eight leadless chip carrier
Packaging	- Encapsulated polyurethane foam

SSFDR Specifications

Form Factor	- 7.12 X 7.0 X 1.55 in. (77.25 in.^{3})
Weight	- 3 lb
Power	- 1.1 W (max)
Number of Modules	- 25 (max)
Number of Modules (B-720)	- 5 with devices and 20 dummy
Memory Capacity	- 6 Mbits* (32 Kbit chips)
Packaging	- Aluminum, fiberglass, intumescent coating

*Only 32 Kbit EEPROM devices were available for this development. Currently, 64 Kbit devices are available that would effectively increase the maximum SSFDR capacity to 12 Mbit.

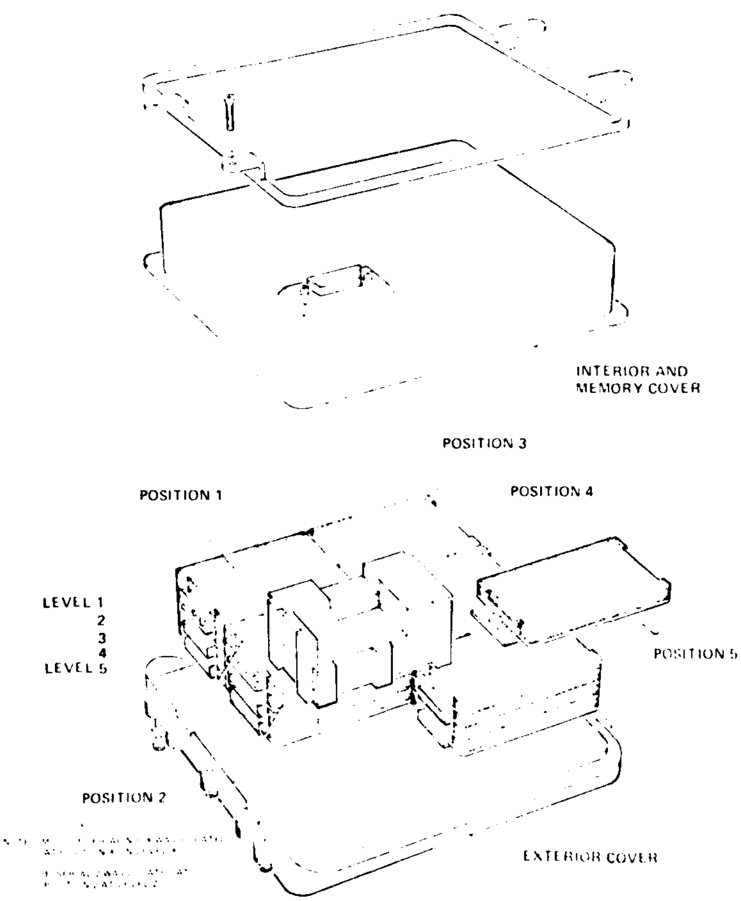

Figure 4
SSFDR MEMORY MODULE ARRANGEMENT

3. The B-720 SSFDR contained 5 memory modules and 20 dummy modules. Each of the five memory modules contained two 32 Kbit memory chips (64 Kbits total). The five memory modules were spaced to measure thermal gradients within the SSFDR. The memory modules/chips (320 Kbits total) were preprogrammed with alternating ones and zeros (checkerboard pattern) prior to CPL/B-720 installation. Also, temperature stick-on indicators were attached to each memory module and interior and exterior SSFDR covers prior to CPL/B-720 installation.

CPL DEVELOPMENT

4. The design concept for the RBA-46 CPL was formulated by Mr. D. M. Watters, NAVAIRTESTCEN, in early 1983. The design concept included the following new features currently not included in production CPL's:

a. Overt radio beacon transmission at 121.5 MHz (civilian), 243 MHz (military), and 406 MHz (SARSAT) emergency frequencies.

b. Covert radio beacon transmission (spread frequency 2.55 to 300 MHz transceiver-transponder).

c. Remote transceiver frequency selection switch.

d. Remote overt/covert frequency selection switch.

e. Automatic antenna tuning.

f. Visual Marker Strobe (VMS).

g. Pyrotechnic operated CPL release unit.

5. Given these technical development requirements and contractural funding and schedule constraints, a detailed feasibility study was conducted and reported (reference 1). It was concluded in this study that the following, although technically feasible, could not be implemented in the B-720 RBA-46 CPL:

a. 406 MHz SARSAT transmitter (hardware unavailable).

b. Covert radio beacon transceiver/transponder (AN/PRC-112(V) not available).

c. Remote frequency selection switches.

d. Automatic antenna tuning.

6. The B-720 RBA-46 CPL design configuration was established as shown in figure 5 with electronic circuitry and space provisions to implement the design configuration, figure 6, after the B-270 CID. The B-720 RBA-46 CPL overall specifications are as follows:

Form Factor	- 23 X 26 X 4.5 in. (1,200 in.^{3})
Weight (with SSFDR)	- 11 lb
Power Supply	- $LiSO_2$ Battery Pack
Power Draw	- 6.6A

Visual Marker Strobe	- Modified ACR/SDU-5
Overt Operating Frequencies	- 121.5 and 243 MHz
Covert Operating Frequencies (AN/PRC-112(V) provisions)	- 255 to 300 MHz
Antenna	- "G" Shaped Broadband
Release Unit	- Pyrotechnic Squib Actuated

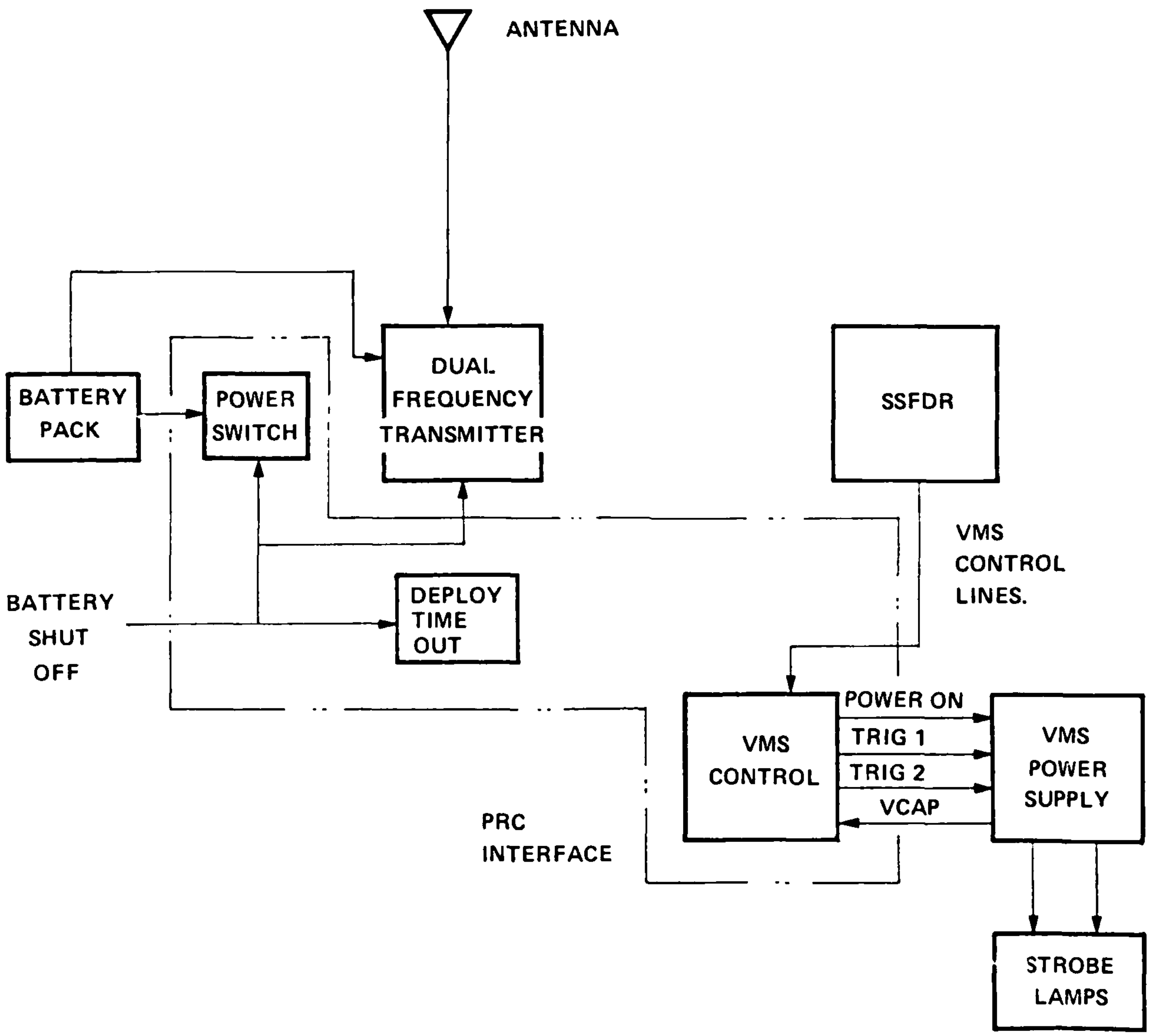

Figure 5
B-720/RBA-46 PAYLOAD BLOCK DIAGRAM

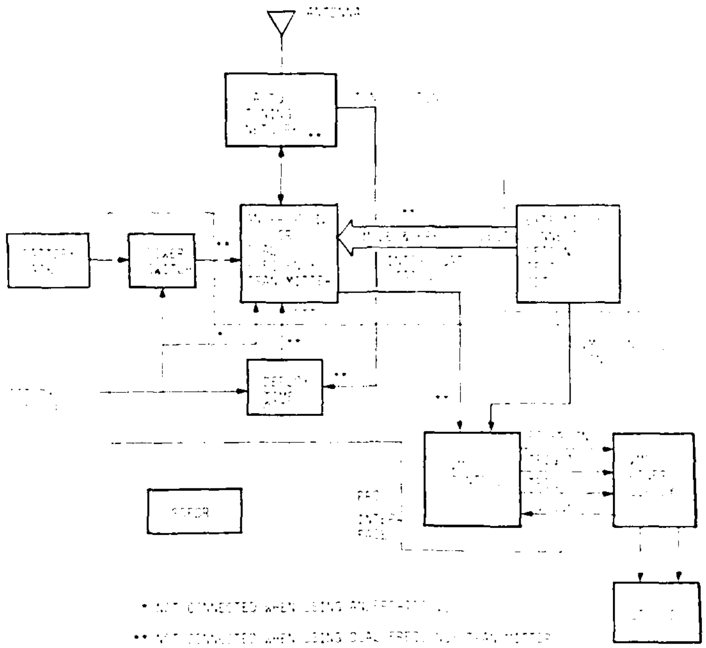

Figure 6
RBA-46 LOCATION RELATIVE TO B-720 AFTER CID

B-720 SSFDR/CPL CID

7. The NASA/FAA B-720 impacted onto the dry lakebed at Edwards AFB at 0922 on 1 December 1984. The engines on the left wing struck the ground first and yawed the aircraft to the left. The aircraft continued into the crash site grid striking the rhinos and strikers, which ripped open the right inboard engine and wing tanks. A fireball then erupted from the right inboard engine engulfing the aircraft and the RBA-46 SSFDR/CPL. At the time of initiation of the fire, the RBA-46 airfoil had not ejected. The aircraft continued down the crash site grid, sliding and yawing to the left. The right wing separated from the fuselage, violently tumbling and spilling fuel, eventually coming to rest on the left side of the aircraft. The aircraft continued to slide finally coming to rest on the left edge of the gravel crash site grid. The CPL RBA-46 did not separate from the aircraft until the aircraft came to rest. It is clearly visible from video and camera coverage that, when the airfoil did release, the aircraft was at a yaw angle of about 30 to 45 deg.

8. The radio beacon transmission was actuated and received by the Navy P-3A chase aircraft for a short time, after which reception was lost. The pilot reported that he received a signal on both 121.5 and 243 MHz for a period of approximately 5 sec. Five minutes after the crash, a portable direction finding unit located on the roof of the NASA Dryden Flight Research Facility, 4 miles distant from the crash, was unable to pick up the beacon transmission.

9. The fire crews started fighting the fires approximately 90 sec after the time of impact. The crews continued to spray the fire with foam for over an hour and a half. The foam used by the fire crews is a 3 to 6% solution of AFFF (FC-203 Light Water Brand Aqueous Film Forming Foam) in water.

10. Approximately 4 hr after the crash, the NASA/FAA safing team located the CPL and installed the Battery Shutoff (BSO) on the RBA-46.

11. Navy personnel access to the crash site was allowed on the morning of 2 December 1984. The CPL RBA-46 was found resting top side up, 15 ft forward and 13 ft perpendicular from the tray location on the starboard side of the aircraft. Figure 7 shows the final location of the CPL RBA-46. An immediate inspection indicated the airfoil suffered moderate fire damage with paint peeling but not intumescing. The VMS lamp housings were intact but extensively burned such that it was impossible to see if the lamps had survived. The airfoil suffered minor structural damage, with assorted dents, etc. The SSFDR cavity was intact with the top surface of the recorder being blackened by fire. Figures 8 and 9 show the CPL RBA-46 as found at the B-720 crash site.

12. The extended plunger on the ARU-21 release unit indicated that the pyrotechnic deployment system operated. The radio beacon base (tray) suffered some heat and fire damage and was charred and blackened by smoke.

13. The frangible switch in the nose survived and the switch in the belly was recovered and found to have actuated. It is assumed that this switch fired the ARU-21 squib. There were no other release switches installed in the normally open system in the aircraft.

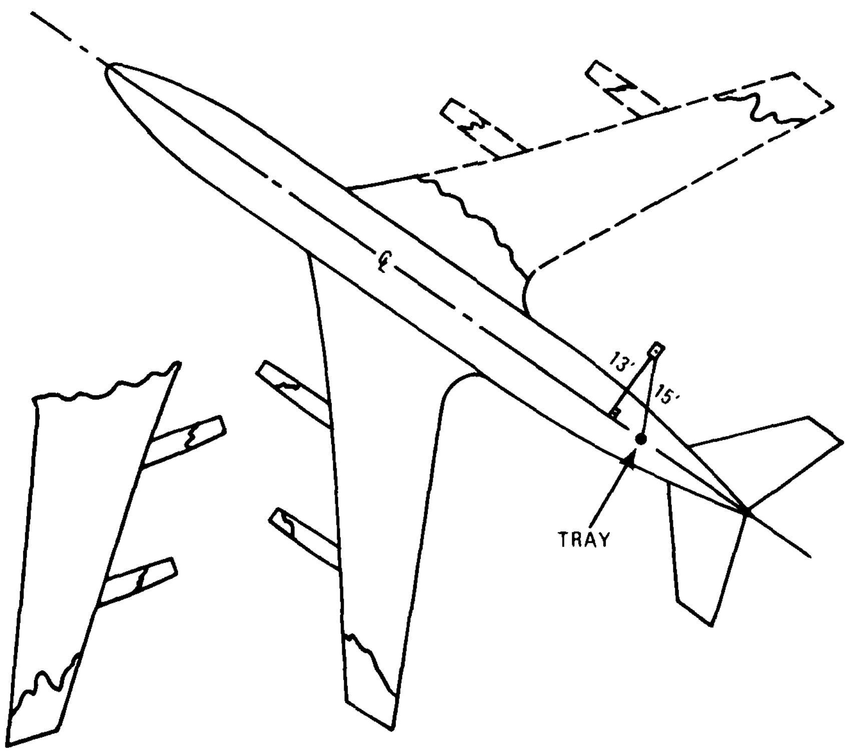

Figure 7
RBA-46 LOCATION RELATIVE TO B-720 AFTER CID

Figure 8
RBA-46 EXTERNAL SURFACE AFTER B-720 CID

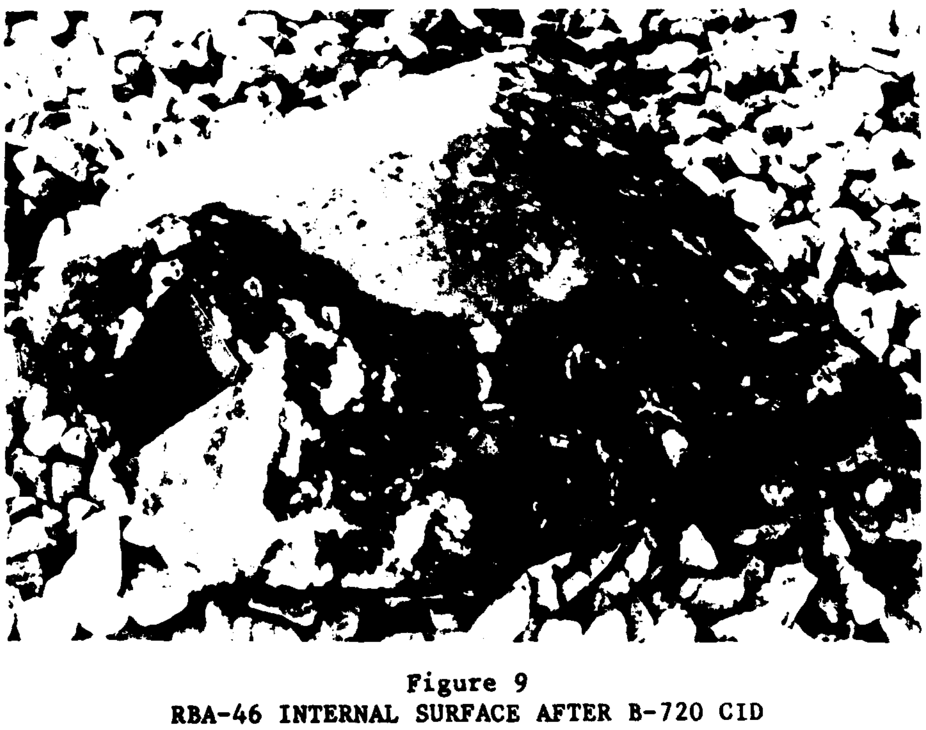

Figure 9
RBA-46 INTERNAL SURFACE AFTER B-720 CID

POST B-720 CID ANALYSIS OF THE RBA-46 SSFDR/CPL

INITIAL INSPECTION

14. On 10 December 1984, the RBA-46, S/N 001, arrived at Leigh Instruments, Ltd., Carleton Place, Ontario, Canada, for an engineering investigation of condition and performance. No modifications or work had been done to the airfoil since it was removed from the crash site at Edwards AFB, California. Initial inspection showed charring on both sides of the airfoil. Structurally, the airfoil was intact with various dents, etc., on its surface. The airfoil was soaked in fluids which were a combination Antimisting Kerosene (AMK) jet fuel and fire fighting foam. Henceforth, this fluid will be referred to as "crash fluid." Upon removal of the BSO, the CPL did not transmit and the strobes did not flash. The airfoil was then subjected to a detailed analysis.

15. The MRU-57 Radio Beacon Base (tray) arrived at Leigh Instruments, Ltd., on 18 January 1985. Initial inspection shows the tray to have suffered mild fire damage, slight charring, paint peeling, and to be covered with smoke deposits. All safety lock wire was intact and the plunger in the ARU-21 Release Unit was in the extended position. Removal and inspection of the squib showed it to have fired. None of the plastic or rubber components showed any sign of melting, indicating that the tray had not been subjected to prolonged fire. The rear mounting hooks showed no sign of damage. The breakaway connector showed minor signs of corrosion caused by the crash fluids. The tray suffered minimal heat damage; as a consequence, it is assumed that the cartridge was fired by the electrical input to the release circuitry and not due to overheating.

PAYLOAD CAVITY ANALYSIS

16. This SSFDR was removed from the RBA-46 airfoil to provide access to the CPL payload cavity, each assembly was then tested to determine its state. Figure 10 shows the payload cavity before disassembly. The SSFDR case was wet with crash fluids. All the assemblies in the cavity had their encapsulating foam soaked with crash fluids. The fluids had seeped in around the SSFDR because there was no seal installed. Sediment due to corrosion was found on the SSFDR connector as well as on the surface of the foam and on the wiring harness. These consisted primarily of green copper deposits. Figures 11 and 12 show the SSFDR before disassembly. The payload assemblies did not shift nor show any signs of sustaining physical damage due to heat (fire) or impact. The wiring harness was intact. The crash fluids consisted of AMK jet fuel and fire fighting foam. The fire fighting foam is electrically conductive, very corrosive, and has a very low surface tension. Low surface tension allows it to flow rapidly into cracks, etc. This fluid extensively damaged various components of the airfoil payload as shown in figure 13.

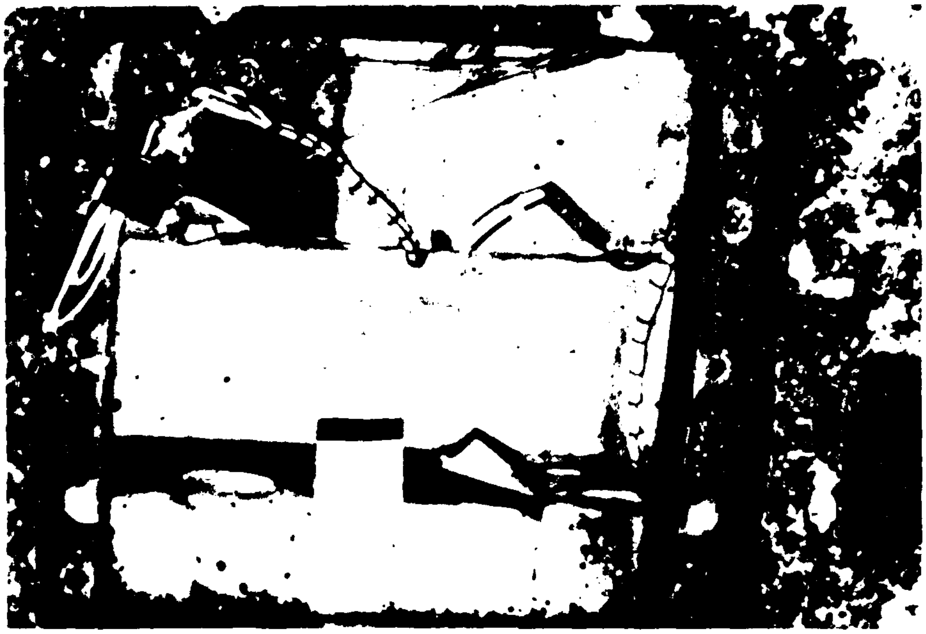

Figure 10
RBA-46 PAYLOAD CAVITY WITH SSFDR REMOVED

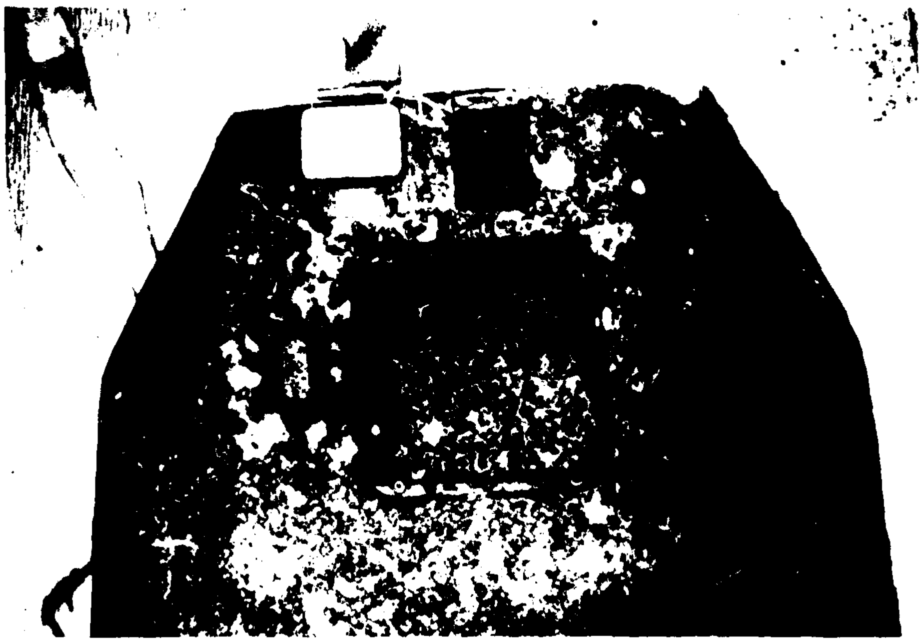

Figure 11
RBA-46 SSFDR EXTERNAL SURFACE PRIOR TO DISASSEMBLY

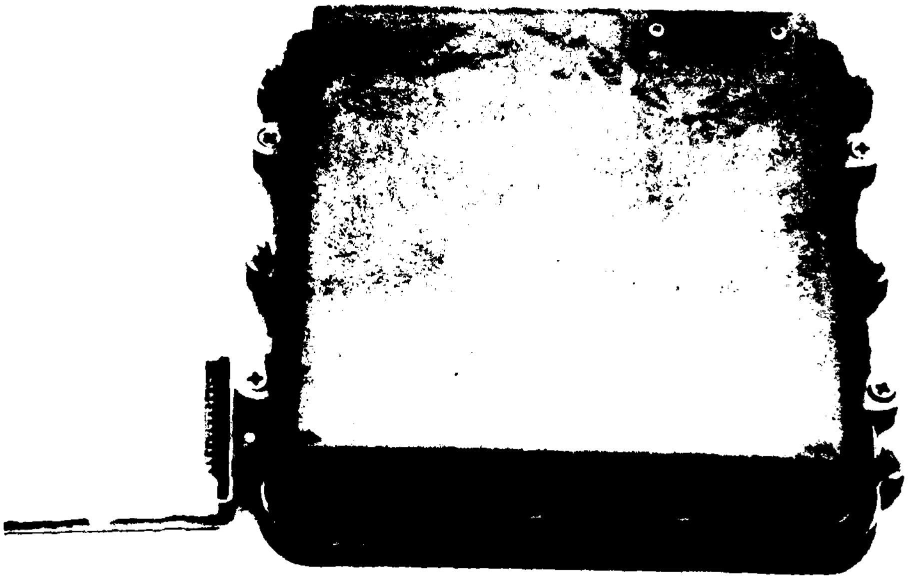

Figure 12
SSFDR INTERNAL SURFACE AFTER B-720 CID

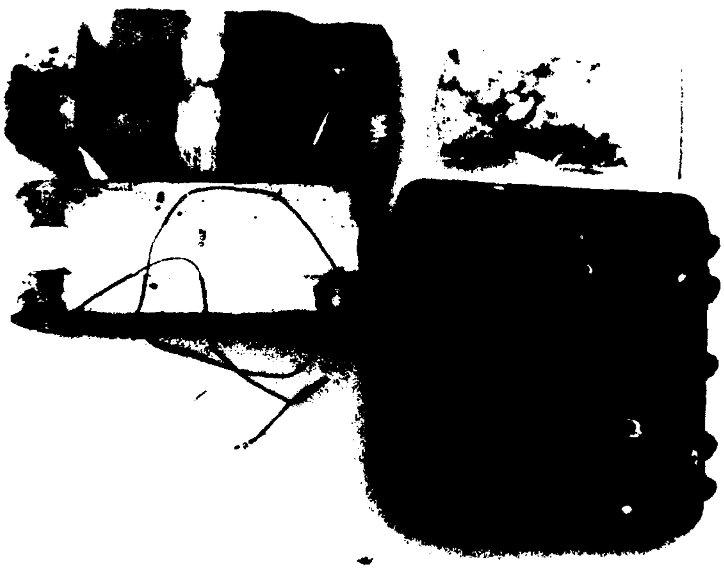

Figure 13
RBA-46 PAYLOAD COMPONENTS REMOVED FROM CAVITY

SSFDR ANALYSIS

17. The SSFDR case cover top was scorched extensively but the intumescent paint did not intumesce. The underside was wet with crash fluids with evidence of smoke. Upon opening, the interior of the recorder was found to be in excellent condition. The SSFDR cover seal was in good shape; however, some crash fluid had seeped into the memory modules. The memory modules showed no signs of physical damage and all data (checkerboard pattern) were read out with no errors. Temperature stickers on the SSFDR indicated readings of 130 and 46 deg for the top and bottom covers. The highest temperature obtained on a memory module was 121°C which was located next to the top cover. The memory module arrangement is shown in figure 14. Table I provides detailed temperature information.

Figure 14
PUNCTURE IN RBA-46 AIRFOIL EXTERNAL SURFACE

Table I

SSFDR TEMPERATURE MEASUREMENTS

Location	Range	Readings
Interior Cover	37°C to 260°C	46°C
Module No. 001	71°C to 110°C	Not Activated
Module No. 002	204°C to 260°C	Not Activated
Module No. 003	37°C to 65°C	49°C
Module No. 004	160°C to 199°C	Not Activated
Module No. 005	116°C to 154°C	121°C
Exterior Cover	37°C to 260°C	130°C

TRANSMITTER MODULE ASSEMBLY (TMA) ANALYSIS

18. The TMA assembly was found to be inoperative because of both failed components and corrosive action. The investigation included a visual examination of damages and an electrical troubleshooting effort. The visual inspection revealed several damages. The foam encapsulating the TMA was soaked with crash fluid making it more corroded than any other assembly in the airfoil. The filter inductors in the battery lines were completely dissolved. The terminals of the TMA were extensively corroded and were shorted together by deposits and crash fluids. Significant areas of the conformal coating were dissolved as well as some of the copper tracking on the solder side of the printed circuit board (PCB). All of the variable capacitors showed signs of corrosion and the C7 capacitor appeared to be detuned by fluids trapped in the foam. The R7 emitter resistor and the Q5 transistor were extensively burned. Sections of the PCB underneath both of these components were burned. The coaxial cable from the TMA to the antenna was separated. Close inspection revealed no signs of corrosion. It is assumed that the connection was broken while the TMA module was being removed from the airfoil and not during the CID or subsequent transport.

19. An engineering troubleshooting exercise was performed to return the TMA to an operative state. The PCB was cleaned and the damaged tracks repaired. Additional component failures were discovered. The base-emitter junction of the Q3 output transistor was open circuited. The transistor showed no signs of heat stress nor is it in close proximity to either of the burned components R7 and Q5. The power supply filter capacitor C9 was found to be short circuited. This component was adjacent to the burned R7 resistor and showed some exterior burn marks which most probably were caused by the overheating of the R7 emitter resistor. After the Q3 transistor and C9 capacitor were replaced, the TMA was operational and no further tests or retuning were performed.

20. It is impossible to determine the exact sequence of failures experienced in the TMA. Several scenarios could be presented using the existing data, but all would be highly speculative. However, some comments and conclusions can be made. The failure of R7 resistor due to heat dissipation would have required excessive current. Since the C10 capacitor provides an RF bypass, it is most probable that the high dc destroyed the R7. Under normal class-C operation, there is no dc through R7. The observed failure of Q3 would not necessarily cause high current through R7. The short circuit in C9 would not cause excessive current through R7. The failure of the Q5 transistor could have been caused by excessive current because of current through R7 or C9 or by excessive power dissipation caused by incomplete biasing. The high impedance in the order of megohms between the base of Q4 and ground would be sufficient to cause the Q5 to operate in its linear region or even to shut off. Operation in its linear region would generate excessive power dissipation.

POWER SUPPLY ANALYSIS

21. Upon inspection, the $LiSO_2$ battery pack was found to be discharged probably due to the shorts in the TMA and other power drawing assemblies.

ANTENNA ANALYSIS

22. Although the antenna was not excavated from the CPL, its measured normalized impedance of 0.7 -j1.1 and 4.4 +j1 at 121.5 and 243 MHz respectively shows it to be of proper electrical character. It was tested to be operational using an RF generator as a source and a spectrum analyzer with a dipole antenna input as a receiver and with a DRF-3 direction finder unit. No further testing or investigation of the antenna was performed.

AN/PRC-112(V) INTERFACE ANALYSIS

23. The AN/PRC-112(V) interface, as with all other assemblies, was coated in crash fluids. It was removed from the cavity and tested to be operational.

VMS ANALYSIS

24. The VMS power supply assembly was found to be nonoperational because crash fluids leaked into the flash tube high voltage (VCAP) line shielding and subsequently soaking the foam in the area of the two trigger coils. This caused numerous shorts which were corrected by removing foam and drying/cleaning the area. Subsequent tests confirmed proper operation of the VMS power supply. The external housing of the strobe lamps (figure 11) was burned and charred. The lamps themselves were undamaged and were actuated to prove both were operational. Due to charring of the lenses, the visibility range of the lamps was considerably limited.

RBA-46 CPL MECHANICAL DAMAGE ANALYSIS

25. As clearly visible in figures 8 and 9, the airfoil suffered fire damage which charred the exterior, peeled the paint, and burned foam under the skin. The paint did not intumesce on any part of the airfoil. Various holes were present in the upper skin, probably due to fuel burning through the skin. Destruction of foam around the edges of the airfoil was most likely due to flames curling around the sides and over the top of the airfoil. Large amounts of the airfoil foam were soaked by crash fluids. The fluids entered via holes in the skin formed by burning and punctures. The airfoil suffered little in the way of impact damage. Several punctures (figure 14) were present but of small size, the largest being approximately 1 ft X 1 3/4 in. deep located on the underside of the airfoil. All four corners were intact and the payload suffered no physical damage due to dents, shifting, etc. The secondary lock and retainer survived with no mechanical damage. Cosmetic damage was encountered due to smoke and fluid residue; however, the lock and retainer were in sound mechanical order with no apparent wear scratches.

THERMAL ANALYSIS

26. Analysis of the B-720 video tape indicates the airfoil was awash in flames for approximately 6 sec. Thermal calculations are based upon the 121°C reading on memory module No. 005. As shown in table I, this module could have attained the 121°C by the application of a heat equivalent to a step function temperature as shown in figure 15.

27. The intumescent coating (Ocean 477) used on the SSFDR is manufactured by Ocean Chemicals Inc., Savannah, Georgia. Discussions with Ocean Chemical's technical representative determined that the coating will intumesce in approximately 6 sec when exposed to a temperature of 925°C (1,700°F). Considering that the intumescent paint did not intumesce and that the fire crews were on site within approximately 1 1/2 min, it can be speculated that the temperature seen by the airfoil was equivalent to a pulse temperature of 160°C to 400°C for a duration of 3 min as shown in figure 15.

28. The apparent discrepancy between the airfoil being awash in flame and the calculated pulse temperature can be explained by a film of cool fuel separating the flames and the airfoil during the crash sequence and prior to deployment.

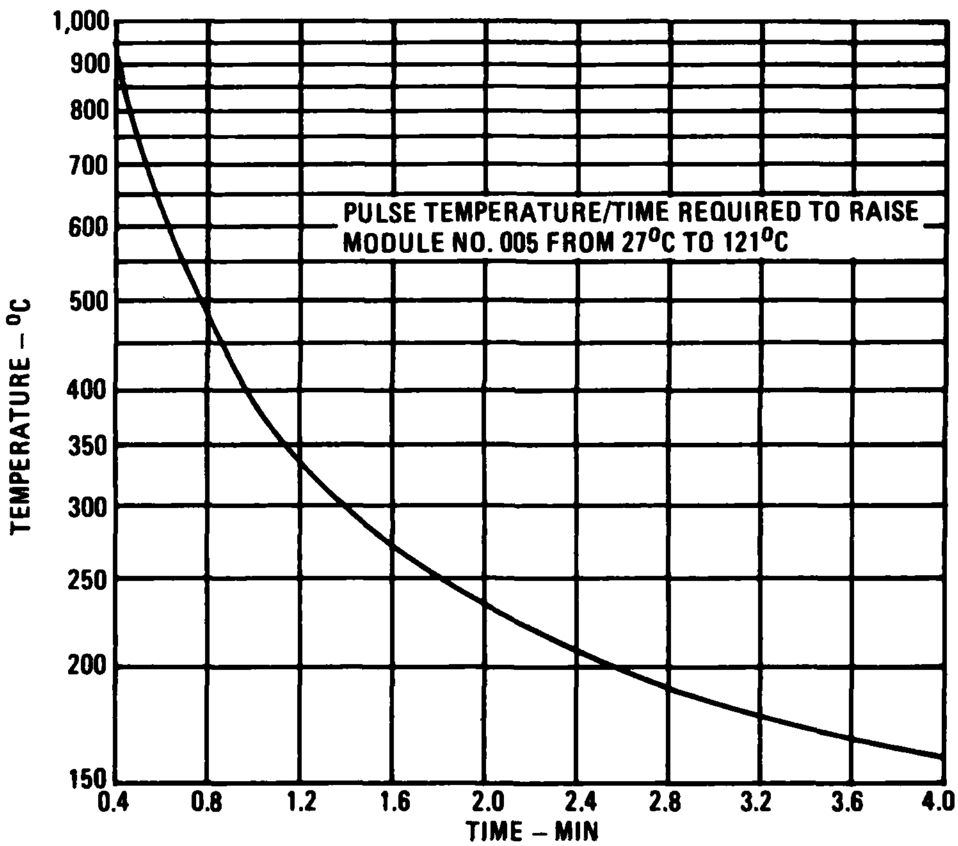

Figure 15
PULSE TEMPERATURE RECEIVED BY SSFDR DURING B-720 CID

B-720 SSFDR/CPL CID CONCLUSIONS

29. The RBA-46 airfoil deployed late in the crash sequence. It is assumed that earlier deployment would have occurred if the nose mounted frangible switch had operated or other normally closed crash detection circuit switches had been installed in the wings.

30. Considerable damage was caused by the ingress of crash fluids into the RBA-46 payload cavity. This damage could account for failure to receive the CPL transmission at some time after the crash but not the brief reception experienced by the P-3A chase aircraft. Several possible explanations exist for the brevity of CPL signal reception:

a. Detuning of the TMA tuned circuit by fuel shortly after deployment.

b. Random component failure shortly after deployment (remote probability).

c. Partial shielding of the chase aircraft from the radiated signal field by the CID airframe (remote probability).

31. The VMS's did not work on initial investigation due to shorting caused by crash fluids. Analysis of the B-720 CID video tapes indicated that the strobe on the top of the airfoil was operating at a 1.1 sec flash repetition rate. This is derived from the 11 sec high speed video repetition rate and the reported 10 to 1 time scaling. The VMS operated for the duration of video coverage (approximately 10 sec real time). Circuit analysis indicates that the VMS should operate several hours independent of any beacon failure if the BSO had not been installed.

32. The SSFDR was not damaged mechanically or thermally by the B-720 CID. All data were recovered and the SSFDR was fully operable.

RECOMMENDATIONS FOR FUTURE SSFDR/CPL IMPROVEMENTS

33. Integrate the AN/PRC-112(V) overt/covert Personal Locator Beacon (PLB) into the RBA-46 CPL for test and evaluation (T&E) of signal strength, range, and quality.

34. Develop test and evaluate (DT&E) a three mode long range overt radio beacon CPL. The three modes should transmit: 15 sec of a modulate swept tone signal; 15 sec of an eight digit unmodulated Morse code signal that transmits the downed aircraft tail number; and 15 sec of a pure unmodulated carrier wave (CW).

35. DT&E an overt 406 MHz SARSAT transmitter integrated into the RBA-46 CPL.

36. DT&E remote overt/covert frequency selection switches for the RBA-64 CPL.

37. Provide payload cavity sealing against fluids on the RBA-46 CPL.

38. DT&E an SSFDR with maximum memory capacity (12 Mbits) using 64 Kbit EEPROM chips.

39. DT&E a Data Acquisition Unit (DAU) capable of conditioning audio using Linear Productine Coding (LPC) at 6 to 8 Kbits/sec.

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REFERENCE

1. David K. Wyld, Geoffery Dobbs and K. Fakhry: Feasibility Study of Proposed B-720 RBA Payload, 951519 Leigh Instruments Limited; Oct 1983.

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